Detection of Uranium by PGAA and and Short-lived NAA

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Neutron Activation Analysis (NAA) is a proven method precise quantitative analysis of ^{238}U. Typically the well-known decay of ^{239}Np ($t_{1/2}$= 2.117 d) is determined because ^{239}U($t_{1/2}$=23.45 m) emits only very low energy gamma rays. For many applications, including cargo screening, the half-life of ^{239}Np is too long to give rapid results. Natural uranium series decay gamma rays can sometimes be used to detect concealed uranium, but their low energies make them readily shielded from view.

At the Budapest Reactor neutron guide we have demonstrated quantitative, simultaneous Prompt Gamma-Ray Activation Analysis (PGAA) of ^{235}U(E_γ=6397 keV) and ^{238}U(E_γ=4060 keV) and Neutron Activation Analysis (NAA) of various ^{235}U neutron induced short-lived fission products with E_γ>2 MeV using a chopped cold neutron beam[1]. Both enriched and natural targets were analyzed. At the LBNL D+D Neutron Generator Facility we have observed fast neutron induced short-lived fission products from ^{238}U in depleted uranium by NAA. An LBNL fission product spectrum recorded in 6 minutes following a 10-minute bombardment of 0.89 kg of ^{238}U is shown in figure 1.

Detection of high-energy gamma rays from short-lived fission products offers a promising method for the detection of concealed nuclear materials. Additional experiments are planned to pulse the LBNL neutron generator and demonstrate real-time detection of small amounts of concealed and / or shielded uranium.

Footnotes and References

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1 G.L. Molnár, Zs. Révay, and T. Belgya, 5th Int. Topical Meeting on Industrial Radiation and Radioisotope Measurement Applications IRRMA-V, Bolgna, Italy 9-14 June 2002.

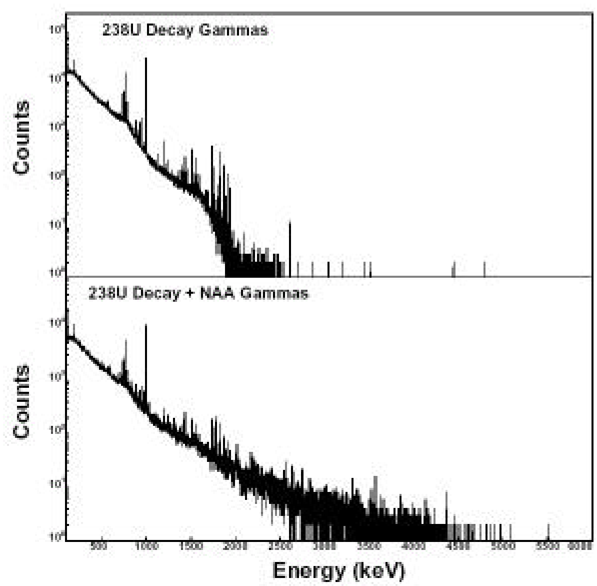

Figure 1. Spectra of ^{238}U decay gamma rays (top) and decay plus NAA gamma rays (bottom) following 10-minute bombardment and 6-minute counting interval at the LBNL D+D neutron generator.